Effect of Stone Crusher Slurry pH and its Impact on Sludge Settling Character at P sand & M sand Mud washing process

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***Abstract*: Concrete itself as a mixture of water, cement, sand and aggregate in addition with a specific ratio. Due to high demand for river sand all over India the quarries were developed to produce eco-friendly P and M sand as per the pollution norms. A quarry is a type of open-pit mine in which dimension stone, rock, construction aggregate, riprap, sand, gravel or slate is excavated from the ground. After the stones are excavated, it is transported to crushers where the jelly produced. From the jelly the crushed sands are produced. One of the great work is to be employed at sludge dewatering station is selection of settling aid or polymers for solid – liquid separation. In this research paper laboratory test was conducted and it has been extended to plant trial to confirm the polymer product efficiency. Final pH of sand slurry affects the anionic polymer settling efficiency.**

***Keywords*: P and M sand, Turbidity, pH, Polymer Anionic polymer, Cationic polymer, settling rate**

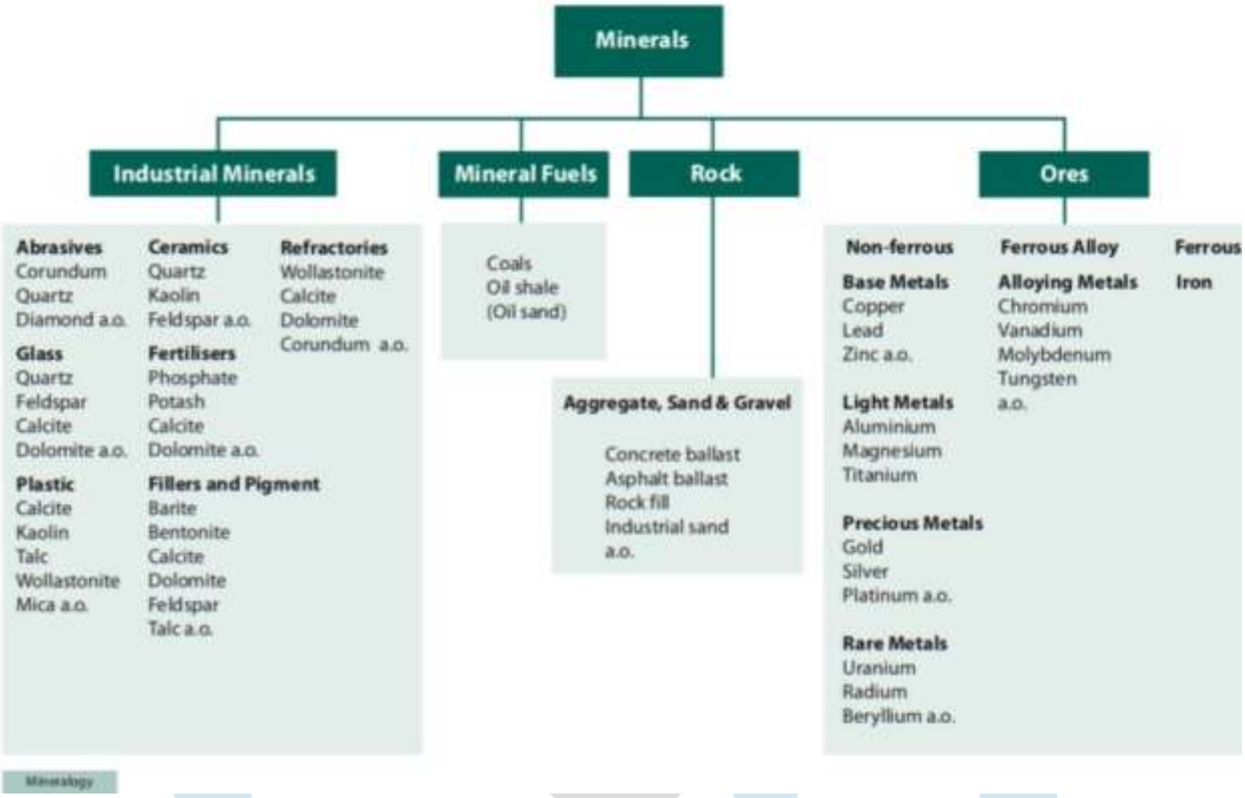
1.0 Introduction

Rapid growth in the infrastructure at global level, the concrete Industry has a pressure to find out the alternate cementing product. The 35 % costing is occupied by the constituent's raw materials, especially by natural river sand. Crushed rock sand has surfaced as a variable alternative to natural river sand and is being now used throughout the world as fine aggregate in concrete. It is manufactured by crushing the quarried stone to a size that will completely pass through 4.75 mm sieve. Due to high demand for river sand, all over India quarries were developed for building operations. Quarrying permit for minor minerals other minerals covered under rule 8-A and 8-C of these for quantity not exceeding 2000 cft under one permit to any person who is an Indian National to extract and remove from any land other than forest land are granted[2] by the Director of Geology and Mining.

Stone crushing produces approximately 5-30 % fine dust .Relatively larger size particles settle down while 50 μm particles – suspended particles recirculation in the water system which cause the slurry pump impeller soaking, pipe line erosion and affects the polishing nature of marble[3] if processed.

Settling rate and turbidity are indirect but provide a simple way to measure the performance of a flocculation process, and are governed by the floc size distribution. The floc size distribution can generally be controlled by proper flocculants selection and appropriate use of flocculant addition and mixing conditions[4].For a successful flocculation, suspension parameters such as pH, ionic strength, temperature, type of flocculants and its properties such as molecular weight, charge density, and molecular structure are important[5]. Accordingly, an appropriate polymer formulation together with suspension conditions especially pH must be optimized.Types of minerals are tabulates in table no: 1

Table: 1 Types of Minerals



In this study, the influence of suspension pH and the anionicity degree of flocculant on flocculation of P and M are extensively discussed in terms of settling rate and turbidity.

2.0 Experiment

Based on the lab evaluation, the plant trial had been conducted at site directly. The process consists of 3 steps.

1. Crushing: Hard stones are crushed in vertical shaft impact crusher where cubical and angular fine aggregate particles are produced

2. Screening: The process of screening helps in the proper grading of the material to make it similar to river sand

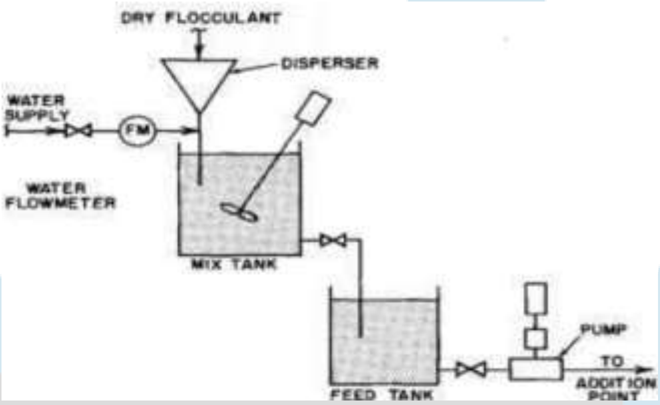
3. Washing: This process helps to remove micro-fine particles .

The crushed stones are called as jelly and fed to crusher.

Fig No: 1 Jelly production

Fig No: 2 Washers

Fig No: 3 Flocculant preparations Tank



The anionic flocculants Na-Polyacrylate (NaPA) is made up of sodium acrylate–acrylamide copolymer and cationic coagulant was used

3. Result and Discussions

Settling rate and turbidity are indirect but provide a simple way to measure the performance of a flocculation process, and are governed by the floc size distribution. To the knowledge of author, there are only a few studies[6] about the flocculation of marble stone have worked on the flocculation of marble suspensions and determined that anionic polymer of high molecular weight (HMW) gave the best results for settling rate and water clarity. Seyrankaya[7] et al studied the effect of pH and polymer type on the flocculation conditions of marble and observed that there is no effect on its settling rate while the low charged anionic flocculants showed the best performance for both settling rate and water clarity. Nishkov and Marinov have shown[8] that 31% anionic polymer gave the best settling rate on marble suspension. The influence of suspension pH and anionicity degree (or charge density) of polymer on flocculation behavior of NSS was however not discussed in the above studies. In addition, no systematic study on the effect of charge density of polymer on flocculation of stone appears in the literature. On the other hand, there are also a few studies on flocculation of calcite mineral. Yarar and Kitchener[9] have studied on selective flocculation of minerals (quartz, calcite and galena) and found that agitation regime (stirring time and polymer addition method) have a significant effect on calcite flocculation. Likewise, a study by Friend and Kitchener[10] on the selective flocculation of calcite from mineral mixtures (calcite–rutile, calcite–quartz) by anionic polymer in the presence of tripolyphosphate used as a dispersant for calcite reported that (i) HMW polymers have greater flocculating power, and (ii) flocculation can be prevented by providing a sufficiently strongly negative zeta potential on calcite surface. Nystrom et al[11] examined the effect of cationic charge density and molecular weight of cationic starch of calcite dispersion and showed that the HMW starch with 20% cationic charge induced the strongest flocculation. In addition, particle size and surface area of particles and slurry flow rate on calcite slurry in a continuous system (linear pipe) had a marked effect on the flocculation.

It is clearly seen that pH 6 and natural pH (pH 7.5) gave the best performance for all the polymers, while pH 11 gave the maximum turbidity by all the polymers for the two suspensions. This may be attributed to destabilization effect of H^+ at low pH and stabilization effect of OH ions at high pH on the negatively charged NS particles. Since, in addition to Ca_2^+, CO_3^{2-} and HCO_3^-

, H^+ and OH^- ions can be considered as potential determining ions for these type stone particles. In addition, at weak acidic or **neutral pH the zeta potential of colloidal particles are in the aggregation (or coagulation) limits (-15 to +15 mv).** So the pH above 11.0 the anionic flocculants does not work irrespective of polymer character. At that time High Molecular Weight Cationic polymer is to be applied to get fast settling and proper dewatering.

Fig No: 4 Common collections Tank

Fig No: 5 Slurry pH 10.5 Clarifier Over Flow: Anoinc Flocculant Application

Fig No: 6 Slurry pH 12.5 Clarifier Over Flow : Cationic coagulant Polymer Application

Fig No: 7 Sludge thickening

4.0 Conclusions

It was concluded that destabilization effect of H^+ at low pH and stabilization effect of OH^- ions at high pH on the negatively charged stone particles was observed .Since, in addition to Ca_2^+, CO_3^{2-} and HCO_3^-, H^+ and OH^- ions can be considered as potential determining ions on stone particles. The polymer charge density and the suspension pH play a crucial role on the flocculation of crushed stone washing process. The type of natural stones has important effect on their settling rate. **High pH can hydrolyze the amide groups High pH can hydrolyze the nonionic amide groups (–$CONH_2$) of PAA or Na-PA and convert to carboxylate (–COO^-H^+) groups**. Consequently, two adjacent negative groups repel each other leading to expanded chains. As well known from the literature the term of "expanded polymer chain" is the most important indicator of the presence of polymer bridging mechanism especially with HMW polymers which fails at high pH by the application of anionic flocculant.

As a rule, catatonics are designed to work at lower pH values, anionic at higher. Nonionic's and quaternaries are only slightly influenced by pH. The general rule should not be interpreted to mean that anionic polymers do not work at low pH; it simply means they are no longer ionic. They may produce good results in flocculating solids at low pH simply because of their nonionic bonds. The same applies to catatonics; even though they are not charged at high pH, they may act as effective coagulants because of their polar groups.

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